Cost-effective Green Hydrogen Production: Single-step Synthesis of Nickel Cobaltite Nanostructures Electrode

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Green hydrogen is a continuously rising way of storing clean energy, wherein electricity from renewable sources is used to split water into oxygen and hydrogen. Unfortunately, current materials used in this process are extremely expensive and unstable, which prevents hydrogen from being a viable clean energy storage method. The aim of this study is to find the most optimized conditions for the synthesis of Nickel Cobaltite ($NiCo_2O_4$) water splitting electrodes using electrodeposition as a synthesis method. 50 different electrodes were synthesized at different time frames, substrates, and electrical currents. The electrodes morphology and performance were then tested and the electrode that showed the most potential was chosen for this study. The morphology and purity of the electrode were then tested by XRD, SEM, and EDS mapping. The electrochemical catalysis performance was tested using linear sweep voltammetry, impedance test, and a chronoamperometry stability test. The results showed the formation of a defect-free thin film on the electrode, high stability, and a current density of 10 mA/cm^2 at 1.56 eV. The solution kinetics were also improved greatly, showing a resistance as low as 10 Ω. Finally, the electrode fabrication costs were reduced by 99.89%; which will lower the cost of hydrogen production immensely. This electrode has the potential to produce cost-effective hydrogen in industrial-based electrolysers in the near future, which will push the industry one step closer to a carbon-emission free future.

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